Study of Rotator Phase Transitions in Alkanes by Specific Heat and Polarization Microscopy Analysis Simultaneously Performed in a Photopyroelectric Calorimeter

U. Zammit [C, S], M. Marinelli, F. Mercuri and S. Paoloni
Università di Roma "Tor Vergata", Dipartimento di Ingegneria industriale, Rome, Italy
zammit@uniroma2.it

The capabilities offered by an upgraded set up of a photopyroelectric calorimeter are exploited to perform simultaneous high temperature resolution calorimetry and polarization microscopy imaging to study various rotator phase transitions in alkane samples. In this way a direct correlation of the features observed in the specific heat vs. temperature profile and the phase textures can be performed. Studies were performed in several transitions between rotator phases which consist of layered structures possessing three dimensional crystalline order in the positions of the molecules, but no long-range orientational order about the molecular long-axis. Studies were performed on the liquid-RII, RII-RI, RI-RV, RII-RV, RIV-RII, RII-RI, RIV-RIII and RIII-RV transitions. In particular the order character of the transitions was investigated by analysing the hysteresis the specific heat shows between heating and cooling measurements. It was shown that the liquid-RII and RII-RI transitions are first-order. The order character of the RI-RV transition varied between 1st and 2nd order for decreasing temperature of the RI phase. It was also found that the disorder associated with the introduction of silica nanoparticles also drives the RI-RV transition toward a second-order character. Disorder attenuated the features of the RII-RI but the first-order character was maintained. Over the liquid-RII transition, the single peak observed in both the specific heats of the pure materials splits into two features at different temperatures. Similar investigations were carried out on the other mentioned transitions and the texture patterns were also systematically studied. The correlation of the patterns with the specific heat curves has helped in establishing, among other things, that the RIII-RV transition previously detected in a compound by x-ray analysis, but not in specific heat studies, does indeed occur and is detected by our specific heat and texture analysis.